

REMARKS/ARGUMENTS

Favorable reconsideration of this Application, as presently amended and in light of the following discussion, is respectfully requested.

This Amendment is in response to the Office Action mailed on May 4, 2005. Claims 1-23, and 70-75 are pending in the Application, Claims 1-16, 19, and 24 stand rejected, and Claims 17, 18, and 20-23 stand objected to as being dependent upon rejected base claims, but would be allowed if rewritten in independent form. Claims 25-69 have been withdrawn from consideration. Claims 1-3, 6, 8, 10, 11 and 17 are amended, Claims 24-69 are cancelled without prejudice or disclaimer, and new Claims 70-75 are added by the present Amendment.

The indication of allowable subject matter is noted with appreciation. New Claims 70-72 correspond to Claims 17, 18, and 20, respectively, re-written in independent form, including the features recited in all intermediate claims. New Claims 73-75 correspond to Claims 21-23. As such, no new matter has been introduced by the newly submitted Claims 70-75; and they are believed to be in condition for allowance.

In the outstanding Office Action, Claim 16 was objected to because of an informality; Claims 1, 4-6, 12 and 24 were rejected under 35 U.S.C. § 102(b) as being anticipated by Aoyama et al. (U.S. Patent No. 5,990,608, hereinafter “Aoyama”); Claims 2-3 and 9-10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Aoyama; Claims 7-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Aoyama in view of Oedl et al. (U.S. Patent No. 6,011,367, hereinafter “Oedl”); Claims 13-14 and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Aoyama in view of Maxwell et al. (U.S. Patent No. 5,508,909, hereinafter “Maxwell”); Claim 15 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Aoyama in view of Maxwell and further in view of Tang (U.S.

Patent No. 6,195,332); Claim 19 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Aoyama in view of Watanabe (U.S. Patent No. 5,003,533).

As to the objection to Claim 16 based on recitation of the expression “can be,” that expression in Claim 17 has been amended to read “configured to be.” Applicants note with appreciation the time taken by the Examiner to identify specific areas needing revisions. Applicants respectfully request reconsideration of the objection to Claim 16. In addition, in view of the present amendment, it is believed that all pending claims are definite and no further rejection on that basis is anticipated. If, however, the Examiner disagrees, the Examiner is invited to telephone the undersigned who will be happy to work with the Examiner in a joint effort to derive mutually acceptable language.

As to the rejection of Claims 1, 4-6, 12 and 24 under 35 U.S.C. § 102(b), Applicants respectfully submit that presently amended Claim 1 is not anticipated by Aoyama because each and every element as set forth in that claim is not found, either expressly or inherently described, in the cited reference. In an anticipation rejection, the identical invention must be shown in as complete detail as is contained in the claim.¹

Amended Claim 1 is directed to a motion control system is recited, comprising, among other features, a central controller comprising a propagation delay parameter measuring mechanism to measure first and second propagation delay parameters between the central controller and respective first and second slaves, the first and second propagation delay parameters being communicated to the respective slaves by a data network configured to place the first and second slaves in communication with the central controller. Each of the slaves in the recited motion control system also comprises a phase-locked loop timing

¹ See MPEP 2131: "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference," (Citations omitted) (emphasis added). See also MPEP 2143.03: "All words in a claim must be considered in judging the patentability of that claim against the prior art."

mechanism to establish timing at which a respective actuator is to be actuated. Non-limiting support for the subject matter amended to Claim 1 is found, for example, on page 19, line 19 – page 20, line 29 and on page 29, line 7 – page 30, line 12 of Applicants' specification and FIGS. 7-16. Therefore, the amendment to Claim 1 is not believed to raise a question of new matter.²

As disclosed in the specification, the claimed invention advantageously provides a motion control system designed to minimize wiring, while retaining the flexibility of a centralized control system (Specification, page 1, lines 6-8). Location of the mechanism for measuring propagation delay parameters in the central controller permits an accurate reconstruction at each node of a master global clock in the system by the determination of respective propagation delay parameters between the central controller and each actuator by the controller without requiring separate propagation time measurement circuitry at each slave (Specification, page 7, lines 13-16), not only does this eliminate redundant timer circuitry at each node but it also permits the measurement of the propagation delays for both directions on a ring.³

The Office Action asserts (1) that the combination of each servo amplifier SA1, SA2 with corresponding servo motors M1, M2 in Aoyama forms a slave, and (2) that the timer circuit in each slave is the timing mechanism recited in Claim 1. As recognized in the outstanding Official Action, according to the teachings of Aoyama, besides the timer circuits disposed in the CNC device 10, each servo amplifier SA1, SA2 comprises a separate timer

² See MPEP 2163.06 stating that "information contained in any one of the specification, claims or drawings of the application as filed may be added to any other part of the application without introducing new matter."

³ See, for example, Specification, page 22, lines 12-17. In addition, in one embodiment, when all of the slaves in the ring have been discovered, enumerated, and configured, it is determined if the ring is complete and the total time taken for the MQT to travel from the P0 port of the master 36 to Q port of the master 36 is measured (as illustrated in FIG. 14). The total delay time is then used by the master 36 to compute the delay of the return link 3.

circuit 206. Propagation delays are then determined by sending a timing signal from the CNC controller through to the end servo amplifier SA1, SA2 and by using the timing circuit in each servo amplifier SA1, SA2 to measure a propagation delay between neighboring servo amplifiers.

Aoyama explains this process as follows.⁴ The CNC device 10 first transmits a delay time measurement packet to the upstream servo amplifier SA1, which re-transmits it to the servo amplifier SA2. The reception of the delay time measurement packet causes each slave to send back a reply delay time measurement packet (Aoyama, col. 8, line 50) and to start measuring time with the second timer 213 (Aoyama, col. 8, line 49). When the first servo amplifier SA1 receives the reply delay time measurement packet from the second servo amplifier SA2, the second timer 213 therein is stopped (Aoyama, col. 9, line 8). However, first servo amplifier SA1 does not repeat the reply delay time measurement packet to the second servo amplifier SA2. Thus the second timer in the first servo amplifier SA1 represents the round trip propagation time to the second servo amplifier SA2. Once all time delay measurements are completed, the second timers 213 are subsequently read back, one at a time, in response to a further command packet from the CNC device 10 (Aoyama, col. 9, line 19). Applicants respectfully submit that the device of Aoyama, as disclosed and understood by those of ordinary skill in the art, is restricted to a daisy-chain⁵ connection of servo amplifiers and is inapplicable to a ring topology, a full duplex ring network, and the counting of slaves in the network, as recited in several dependent claims.

As now more clearly recited in Claim 1, the propagation delay parameter measurement is performed at the central controller and propagation delay parameters are

⁴Aoyama col. 8, line 24 – col. 9, line 25.

⁵Aoyama, col. 3, lines 65-67.

communicated from the central controller to the slaves by a data network, thus eliminating the need for timer circuits in each servo amplifier and permitting effective timing corrections to be set-up solely by means of data communication network messages rather than resorting to additional timing signals generated by those timer circuits. The claimed invention thus eliminates the timer circuits included in the Aoyama servo amplifiers, while maintaining the communication between the central controller and each slave synchronized using cables, connectors, and isolation circuitry already present in the master controller and each of the slaves.

Claim 1 also now recites that the timing mechanism in each slave comprises a phase-locked-loop timing mechanism, thus further distinguishing over the teachings Aoyama. In Aoyama, timing corrections are implemented by pre-loading a timer with an offset every time a timing message is received, which results in a system with poor performance in the event of a loss of a timing packet. A phase-locked-loop timing mechanism is less susceptible to poor performance in the even of a time packet loss (e.g., as a result of electromagnetic interference or intermittent connector contacts) because each slave is capable of continuously reconstructing the common network time accurately since the common network time has a frequency that is fixed during network initialisation and the phase-locked-loop timing mechanism at each slave is required only to deal with small node clock rate discrepancies and the phase differences required to correct for propagation delay, thus resulting in a system having a capability to continuously adjust and therefore offer more accurate event timing.

As explained, the present invention advantageously provides a motion control system designed to minimize wiring, while retaining the flexibility of a centralized control system, permitting an accurate reconstruction at each node of a master global clock in the system by the determination of respective propagation delays between a central controller and each

actuator and the timing of operations of each actuator based on the respective propagation delays for each actuator, thereby eliminating uncertainties introduced by the respective transport delays.

Accordingly, Applicants respectfully submit that Aoyama does not anticipate the invention recited in Claim 1 because Aoyama does not teach the measurement of all propagation delay parameters at a central controller, the communication of the derived delay parameters to respective slaves by a data network, and slaves with a phase-locked loop timing mechanism. Instead, Aoyama teaches a very different “daisy chain” approach, which is the antithesis of central control in the determination of timing delays with timing corrections, which are implemented in each servo-amplifier by pre-loading a timer with an offset every time a timing message is received. Accordingly, it is respectfully submitted that amended Claim 1 and Claims 4-6 and 12 dependent therefrom patentably define over Aoyama and are allowable.

As to the obviousness rejection of Applicants’ claims, Applicants respectfully submit that Aoyama, Oedl, Maxwell, Tang, and Watanabe, neither individually nor in any combination, support a *prima facie* case of obviousness of the invention recited in amended Claim 1. This is so because, even when combined, the cited prior art references do not remedy the above-noted deficiencies of Aoyama and not teach or suggest all of the claim limitations recited therein. Accordingly, it is respectfully submitted that Claims 2, 3, 7-10, 13-16, and 19 also patentably distinguish over Aoyama, Oedl, Maxwell, Tang, and Watanabe, and likewise are allowable.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application, and the present application is believed to be in

condition for formal Allowance. A Notice of Allowance for Claims 1-23, and 70-75 is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact Applicants' undersigned representatives at the below listed telephone number.

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